

CLAIMS

1. A fuel cell system comprising:
 - a fuel cell stack having a fuel electrode and an oxidant electrode provided facing each other with an electrolyte membrane in between;
 - 5 a gas supply unit which supplies a fuel gas to the fuel electrode and supplies an oxidant gas to the oxidant electrode to cause the fuel cell stack to generate power;
 - a circulation unit having a circulation passage to return an excess fuel gas, discharged from the fuel cell stack, to a fuel gas inlet port of the fuel cell stack;
 - 10 a gas discharge unit having an open/close valve which discharges a gas present on the fuel electrode from the circulation passage; and
 - a control unit which calculates an integration value resulting from integration of a value per unit time concerning a gas to be supplied to the fuel electrode, which varies in accordance with a gas pressure of the oxidant electrode and a temperature of the fuel cell stack,
- 15 when the open/close valve is set in a closed state, and controls the open/close valve in an open state when the integration value becomes equal to or greater than an accumulation threshold value.
2. The fuel cell system according to claim 1, wherein the control unit calculates the integration value by making the value per unit time concerning the gas to be supplied to the fuel electrode larger as the temperature of the fuel cell stack gets higher.
- 20 3. The fuel cell system according to claim 1, wherein the control unit calculates the integration value by making the value per unit time concerning the gas to be supplied to the fuel electrode larger as the gas pressure of the oxidant electrode becomes higher.
- 25 4. The fuel cell system according to claim 1, wherein the control unit controls the open/close valve by making the accumulation threshold value smaller as a temperature of the fuel gas becomes higher.

5. The fuel cell system according to claim 4, further comprising:
a coolant medium supply unit which supplies a coolant medium to the fuel cell stack;
and
a coolant medium temperature detecting unit which detects a temperature of the coolant
5 medium,
wherein the control unit predicts the temperature of the fuel cell stack or the fuel gas
temperature based on the coolant medium temperature detected by the coolant medium
temperature detecting unit, and changes the accumulation threshold value.

- 10 6. A fuel cell system comprising:
a fuel cell stack having a fuel electrode and an oxidant electrode provided facing each
other with an electrolyte membrane in between;
a gas supply unit which supplies a fuel gas to the fuel electrode and supplies an
oxidant gas to the oxidant electrode to cause the fuel cell stack to generate power;
15 a circulation unit having a circulation passage to return an excess fuel gas, discharged
from the fuel cell stack, to a fuel gas inlet port of the fuel cell stack;
a gas discharge unit having an open/close valve which discharges a gas present on the
fuel electrode from the circulation passage; and
a control unit which calculates an integration value resulting from integration of a
20 discharge gas flow rate from the open/close valve, which varies in accordance with a gas
pressure of the fuel electrode and a temperature of the fuel gas, when the open/close valve is set
in an open state, and controls the open/close valve in a closed state when the integration value
becomes equal to or greater than a discharge threshold value.
- 25 7. The fuel cell system according to claim 6, wherein the control unit calculates the
integration value by making the discharge gas flow rate from the open/close valve smaller as the
temperature of the fuel gas discharged from the open/close valve is higher.
- 30 8. The fuel cell system according to claim 6, wherein the control unit calculates the
integration value by making the discharge gas flow rate from the open/close valve smaller as the

gas pressure of the fuel electrode is lower.

9. The fuel cell system according to claim 6, wherein the control unit makes the discharge threshold value larger as the fuel gas temperature of the fuel electrode is higher.

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10. The fuel cell system according to claim 9, further comprising:

a coolant medium supply unit which supplies a coolant medium to the fuel cell stack; and

10 a coolant medium temperature detecting unit which detects a temperature of the coolant medium,

wherein the control unit predicts the fuel gas temperature based on the coolant medium temperature detected by the coolant medium temperature detecting unit, and calculates the integration value.

15 11. A fuel cell system comprising:

a fuel cell stack having a fuel electrode and an oxidant electrode provided facing each other with an electrolyte membrane in between;

a gas supply unit which supplies a fuel gas to the fuel electrode and supplies an oxidant gas to the oxidant electrode to cause the fuel cell stack to generate power;

20 a circulation unit having a circulation passage to return an excess fuel gas, discharged from the fuel cell stack, to a fuel gas inlet port of the fuel cell stack;

a gas discharge unit having an open/close valve which discharges a gas present on the fuel electrode from the circulation passage; and

a control unit which controls an open/closed state of the open/close valve,

25 wherein the control unit calculates an integration value resulting from integration of a value per unit time concerning a gas to be supplied to the fuel electrode, which varies in accordance with a gas pressure of the oxidant electrode and a temperature of the fuel cell stack, when the open/close valve is set in a closed state, and controls the open/close valve in an open state when the integration value becomes equal to or greater than an accumulation threshold value, and

calculates an integration value resulting from integration of a discharge gas flow rate from the open/close valve, which varies in accordance with a gas pressure of the fuel electrode and a temperature of the fuel gas, when the open/close valve is set in an open state, controls the open/close valve in a closed state when the integration value becomes equal to or greater than a 5 discharge threshold value, and sets an initial value of the integration value to be calculated in case of controlling the open/close valve in the open state lower as the temperature of the fuel cell stack when the open/close valve is operated to the closed state from the open state is higher.

12. A control method of a fuel cell system which comprises a fuel cell stack having a fuel 10 electrode and an oxidant electrode provided facing each other with an electrolyte membrane in between, a gas supply unit which supplies a fuel gas to the fuel electrode and supplies an oxidant gas to the oxidant electrode to cause the fuel cell stack to generate power, a circulation unit having a circulation passage to return an excess fuel gas, discharged from the fuel cell stack, to a fuel gas inlet port of the fuel cell stack, and a gas discharge unit having an open/close valve 15 which discharges a gas present on the fuel electrode from the circulation passage, comprising steps of:

calculating an integration value resulting from integration of a value per unit time concerning a gas to be supplied to the fuel electrode, which varies in accordance with a gas pressure of the oxidant electrode and a temperature of the fuel cell stack, when the open/close 20 valve is set in a closed state; and

controlling the open/close valve in an open state when the integration value becomes equal to or greater than an accumulation threshold value.

13. A control method of a fuel cell system which comprises a fuel cell stack having a fuel 25 electrode and an oxidant electrode provided facing each other with an electrolyte membrane in between, a gas supply unit which supplies a fuel gas to the fuel electrode and supplies an oxidant gas to the oxidant electrode to cause the fuel cell stack to generate power, a circulation unit having a circulation passage to return an excess fuel gas, discharged from the fuel cell stack, to a fuel gas inlet port of the fuel cell stack, and a gas discharge unit having an open/close valve 30 which discharges a gas present on the fuel electrode from the circulation passage, comprising

steps of:

calculating an integration value resulting from integration of a discharge gas flow rate from the open/close valve, which varies in accordance with a gas pressure of the fuel electrode and a temperature of the fuel gas, when the open/close valve is set in an open state; and

5 controlling the open/close valve in a closed state when the integration value becomes equal to or greater than a discharge threshold value.

14. A control method of a fuel cell system which comprises a fuel cell stack having a fuel electrode and an oxidant electrode provided facing each other with an electrolyte membrane in
10 between, a gas supply unit which supplies a fuel gas to the fuel electrode and supplies an oxidant gas to the oxidant electrode to cause the fuel cell stack to generate power, a circulation unit having a circulation passage to return an excess fuel gas, discharged from the fuel cell stack, to a fuel gas inlet port of the fuel cell stack, a gas discharge unit having an open/close valve which discharges a gas present on the fuel electrode from the circulation passage, comprising
15 steps of:

calculating an integration value resulting from integration of a value per unit time concerning a gas to be supplied to the fuel electrode, which varies in accordance with a gas pressure of the oxidant electrode and a temperature of the fuel cell stack, when the open/close valve is set in a closed state;

20 controlling the open/close valve in an open state when the integration value becomes equal to or greater than an accumulation threshold value;

calculating an integration value resulting from integration of a discharge gas flow rate from the open/close valve, which varies in accordance with a gas pressure of the fuel electrode and a temperature of the fuel gas, when the open/close valve is set in an open state;

25 controlling the open/close valve in a closed state when the integration value becomes equal to or greater than a discharge threshold value; and

setting an initial value of the integration value to be calculated in case of controlling the open/close valve in the open state lower as the temperature of the fuel cell stack when the open/close valve is operated to the closed state from the open state is higher.